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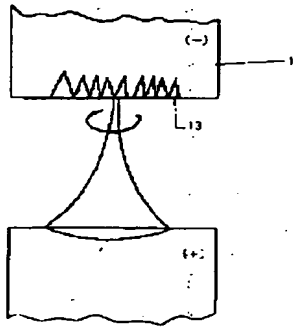
(54) ELECTRODE FOR ELECTRIC DISCHARGE MACHINING, AND METAL SURFACE TREATING METHOD BY ELECTRIC DISCHARGE

(57) Abstract:

PURPOSE: To eliminate the breakableness of a green compact electrode and also apply secondary machining to an article to be treated through only changing an electric discharge electric condition, by forming an electric discharge electrode with compression-molding carbide such as WC and Ti, boride such as TiB2 and ZrB2, and nitride such as TiN and ZrN to perform temporary sintering at a temperature of sintering temperature or lower to form an electrode for electric discharge machining.

CONSTITUTION: A simple substance or a mixture of two or more kinds, cited below, is compression-molded: carbide such as WC, TiC, TaC, ZrC, SiC, and VC; boride such as TiB2 and ZrB2, and nitride such as TiN and ZrN. Then, the compression molded body is temporarily sintered at a temperature of sintering temperature or lower to form an electric discharge electrode. In this electrode, the hardness of a surface layer is increased when machining is made by a plus electrode than by a minus electrode. This reason is estimated because of the fact that the electrode 1 in plus causes an article to be treated into minus to increase an electrode discharge trace current density to obtain the resulted article to be treated reheated at a high sintering temperature. Resultingly the breakableness of the electrode 1 is eliminated even in electric discharge machining having nonconsumptiveness.



JAPANESE [JP,08-300227,A]

CLAIMS DETAILED DESCRIPTIONTECHNICAL FIELD PRIOR ARTEFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATIONEXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] carbide, such as WC, TiC, TaC, ZrC, SiC, and VC, and TiB2 and ZrB2 etca boride, and TiN and ZrN etc. --electrode for electric spark machining characterized by having pressed the simple substance of a nitride, or two or more sorts of mixture, having carried out the temporary quenching join and constituting from temperature below sintering temperature
[Claim 2] The electrode for electric spark machining characterized by having carried out the temporary-quenching join of the green compact of an easy material of carbonization, such as Ti, V, and Ta, and constituting it from temperature below sintering temperature.
[Claim 3] The metal finishing method by the electric discharge characterized by forming an enveloping layer in the above-mentioned processed material front face by pressing the simple substance of nitrides, such as borides, such as carbide, such as WC, TiC, TaC, ZrC, SiC, and VC, and TiB2, ZrB2, and TiN, ZrN, or two or more sorts of mixture, carrying out a temporary-quenching join at the temperature below sintering temperature after that, and performing an electrodischarge treatment for this to processed material as a consumable electrode of an electron discharge method.
[Claim 4] The metal finishing method by the electric discharge which carries out the temporary quenching join of the green compact of an easy material of carbonization, such as Ti, V, and Ta, at the temperature below sintering temperature, and is characterized by performing an electrodischarge treatment to processed material after that into the working liquid which produces carbon by the pyrolysis according this to electric discharge as a consumable electrode of an electron discharge method.
[Claim 5] The metal finishing method by the electric discharge according to claim 3 or 4 characterized by changing electrode polarity and electric discharge electrical-and-electric-equipment conditions into the conditions which choose the conditions which an electrode material deposits in the electrodischarge treatment in the 1st phase to processed material, and go up a degree of hardness in the electrodischarge treatment in the 2nd phase to the above-mentioned processed material.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the metal finishing method by the electrode for electric spark machining and electric discharge which perform an electrodischarge treatment to the processed material which needs corrosion resistance and abrasion resistance, such as metal mold, a tool, an internal combustion engine, and a gas turbine.
[0002]
[Description of the Prior Art] As indicated by the former, for example, JP,54-48615,A It is 10 micrometers by the surface treatment by electric discharge. When the above thick enveloping layer is formed, Primary processing (deposition processing) is performed using the green compact electrode which consists of tungsten carbide powder, cobalt powder, etc. Next, the metal finishing method by the electric discharge which consists of two processes of exchanging for electrodes with comparatively few electrode wears (a nonconsumable electrode being called below), such as a copper electrode, and performing secondary elaboration (remelting processing) is learned.
[0003] Although this method is a method which was extremely excellent in the high degree of hardness forming the large fine ceramics layer of the adhesion force in the thickness of several 10 micrometers, it is necessary to exchange it to a nonconsumable electrode in secondary elaboration.
[0004] This conventional method is explained further. That is, it is difficult for the material of the high-melting point of fine ceramics (WC, TiC, TaC, ZrC, SiC, TiB2, ZrB2, TiN, ZrN, etc.), Tungsten W, Molybdenum Mo, etc., etc. for you to make it fully spread to the interior of a work material only in an electric discharge deposit in many cases. The electric discharge deposit of the tungsten carbide of them (the following, WC, and description) is carried out as an example, and the example of an experiment which applied pulse electron discharge method processing to this is explained.
[0005] First, WC powder (3 micrometers of mean particle diameters) is mixed at the end of iron powder (following and Fe powder and description) (9.8 micrometers of mean particle diameters), and a rate of 1:1, and it presses (4t [/square centimeter] compression pressure), and considers as a green compact, this is pasted up on the copper round bar in an electroconductive glue, and a green compact electrode is formed. Subsequently, carbon steel (S55C green wood) is made into processed material, and they are electric discharge electrical and electric equipment conditions (pulse peak value Ip, pulse period taup, and pulse quiescent time taur were changed, and it experimented with the usual **** electric discharge machine shown in drawing 13 .).
[0006] In addition, in drawing 13 , 1 shows the electrode and 2 shows the power supply with which in processed material and 3 a working liquid and 5 supply the servo mechanism of an electrode 1, and, as for 6, a processing tub and 4 supply processing voltage between an electrode 1 and the processed material 2.
[0007] Consequently, although the arc according [a duty factor D] to electric discharge concentrated and the green compact electrode 1 was destroyed on comparatively large processing conditions, on 1.5% or less of conditions, it was stabilized, and the duty factor D exhausted the green-compact electrode 1, without collapsing, and adhered to the front face of the processed material 2. The processing conditions at that time are Ip=20A, taup=16microsecond, and taur=1024microsecond (this is called primary processing). Drawing 14 the control circuit and the

resistance which restricts a transistor and the current to which 8 and 9 flow to ten and 11 flow to each transistors 8 and 9, and 12 are control circuits which control the on-off action of transistors 8 and 9. Moreover, drawing 15 is the pulse-shape view showing the voltage waveform V in a working gap, and current wave form Ip.

[0008] Next, a pulse electron discharge method is carried out in the following way to the processed material 2 obtained by the aforementioned electron discharge method. First, tungsten carbide powder and cobalt powder are mixed, the pressed WC-Co sintered compact (cemented carbide byte material) is pasted up on the copper round bar in an electroconductive glue, and an electrode is constituted. Subsequently, the upper shell pulse electron discharge method of WC and Fe deposit adhering to the front face of the processed material 2 is carried out using this electrode. Processing conditions considered electrode polarity as minus, changed pulse peak value Ip, pulse period taup, and pulse quiescent-time taur, and were processed so that the processed material 2 might not be processed too much. Although the sediment of WC-Fe **** if pulse period taup is short, the pulse peak value Ip is high and floor to floor time is long, pulse period taup is a little long, and the pulse peak value Ip can lessen scattering of the sediment of WC-Fe on low conditions a little (this is called secondary elaboration).

[0009] Only by the electric discharge deposit of primary processing, although the adhesion force of WC-Fe was weak, when the pulse electron discharge method of secondary elaboration was performed to this, it was checked that WC is spread in processed material. Moreover, the degree of hardness of the usual WC-Co sintered compact is about 850 to 950 Vickers hardness Hv also in the case of (WC70, Co30). In the above-mentioned example of an experiment, although there were little WC50, Fe50, and WC of a high degree of hardness, the degree of hardness (Vickers hardness 1000 Hv 1400) (the hardening penetration of S55C is 800 or so Vickers hardness Hv) of the surface treatment layer of a high degree of hardness was obtained rather than it. Moreover, the thickness which can obtain 1000 or more Vickers hardness Hv in the above-mentioned example of an experiment is 60 micrometers. Thickness is large at a grade.

[0010]

[Problem(s) to be Solved by the Invention] In the conventional electrode for electric spark machining, there was the 1st trouble that a green-compact electrode might collapse [the duty factor D of electric discharge] when large (ratio of pulse quiescent time taur to pulse period taup). In addition, besides the organization which is doing compression adhesion being brittle, thermal conductivity and electric resistance become high seemingly, near a discharging point generates heat by the discharge current, electric discharge concentration takes place, and the reason which collapses while a green-compact electrode processes it is considered to generate lack for that near a discharging point is removed greatly, and the partial melting resolidification (it happens by arc discharge) of an electrode.

[0011] Moreover, in the conventional electrode for electric spark machining, there was the 2nd trouble of there having been much exhaustion of an electrode because of a green-compact electrode, and becoming deposition processing instead of remelting sintering.

[0012] Moreover, by the metal finishing method by the conventional electric discharge, when it switched to secondary elaboration conditions without having exchanged to the nonconsumable electrode by secondary elaboration and exchanging an electrode, the electrode broke and there was the 3rd trouble that continuation of processing became difficult.

[0013] Here, the phenomenon by the size is described as the term of a duty factor D. A duty factor D is D= pulse period taup/(pulse period taup+ pulse quiescent time taur) (%), as shown in drawing 3 . as shown in the above-mentioned formula, pulse period taup in 1 cycle (pulse period taup+ pulse quiescent-time taur) electric discharge comes out comparatively, and it is, and a quiescent time rate will be so short that this duty factor D is large, and processing efficiency will improve However, if the average of the current per unit time becomes large, therefore that a duty factor D says that it is large has the high electric resistance of an electrode material and it is low, not only a discharging point but the temperature of the neighborhood of it will become high. [of thermal conductivity] If temperature is high, insulating recovery is not enough, either, therefore it will generate at the same point and the electric discharge which occurs one after another will also become intensive. It becomes the so-called arc discharge (electric discharge without insulating recovery). Therefore, the

specific point generating [electric discharge] collapses and an electrode configuration will also become irregular. A green compact electrode can do the need of taking the small (the above mentioned example 1.5%) duty factor D.
[0014] While it was made in order that the purpose of this invention might solve the 3rd trouble from the above 1st, and canceling the ease of collapsing of a green compact electrode, it aims at offering the metal finishing method by the electrode for electric spark machining and electric discharge which make secondary elaboration possible only by change of electric discharge electrical and-electric-equipment conditions, without exchanging electrodes also in secondary elaboration conditions.
[0015]
[Means for Solving the Problem] The electrode for electric spark machining concerning the 1st invention presses the simple substance of nitrides, such as borides, such as carbide, such as WC, TiC, TaC, ZrC, SiC, and VC, and TiB2, ZrB2, and TiN, ZrN, or two or more sorts of mixture, and they carry out a temporary-quenching join and it constitutes them from temperature below sintering temperature.
[0016] The electrode for electric spark machining concerning the 2nd invention carries out the temporary-quenching join of the green compact of an easy material of carbonization, such as Ti, V, and Ta, and constitutes it from temperature below sintering temperature.
[0017] The metal finishing method by electric discharge concerning the 3rd invention adds and presses sintering support into a simple substance or two or more sorts of mixture, carries out the temporary-quenching join of the nitrides, such as borides, such as carbide, such as WC, TiC, TaC, ZrC, SiC, and VC, and TiB2, ZrB2, and TiN, ZrN, at the temperature below sintering temperature after that, and performs an electrodischarge treatment for this to processed material as a consumable electrode of an electron discharge method.
[0018] The metal finishing method by electric discharge concerning the 4th invention carries out the temporary-quenching join of the green compact of an easy material of carbonization, such as Ti, V, and Ta, at the temperature below sintering temperature, and performs an electrodischarge treatment to processed material after that into the working liquid which produces carbon by the pyrolysis according this to electric discharge as a consumable electrode of an electron discharge method.
[0019] The metal finishing method by electric discharge concerning the 5th invention chooses the conditions which an electrode material deposits well in the electrodischarge treatment in the 1st phase to processed material, and changes electrode polarity and electric discharge electrical and-electric-equipment conditions into the conditions which go up a degree of hardness in the electrodischarge treatment in the 2nd phase to the above-mentioned processed material.
[0020]
[Function] The electrode for electric spark machining which carried out the temporary-quenching join and which pressed the simple substance of nitrides, such as borides, such as the carbide by this invention, such as WC, TiC, TaC, ZrC, SiC, and VC, and TiB2, ZrB2, and TiN, ZrN, or two or more sorts of mixture, and was constituted from temperature below sintering temperature can carry out an electron discharge method, without collapsing also in the electron discharge method of non exhausting polarity.
[0021] The electrode for electric spark machining which carried out the temporary-quenching join of the green compact of an easy material of carbonization by this invention, such as Ti, V, and Ta, and constituted it from temperature below sintering temperature can carry out an electron discharge method, without collapsing also in the electron discharge method of non-exhausting polarity.
[0022] The carbide by this invention, such as WC, TiC, TaC, ZrC, SiC, and VC, Nitrides, such as borides, such as TiB2 and ZrB2, and TiN, ZrN Sintering support is added and pressed into a simple substance or two or more sorts of mixture. After that, A temporary-quenching join is carried out at the temperature below sintering temperature, and the metal finishing method of performing an electrodischarge treatment to processed material as a consumable electrode of an electron discharge method can carry out the electron discharge method of this, without an electrode collapsing also to polar conversion or wide range electric discharge electrical and-electric-equipment conditions.
[0023] The temporary-quenching join of the green compact of an easy material of carbonization by this invention, such as Ti, V, and Ta, is carried out at the temperature below sintering temperature, and the metal finishing method of performing an electrodischarge treatment to processed material

into the working liquid which produces carbon by the pyrolysis according this to electric discharge as a consumable electrode of an electron discharge method can carry out an electron discharge method after that, without an electrode collapsing also to polar conversion or wide range electric discharge electrical-and-electric-equipment conditions.

[0024] The conditions which an electrode material deposits well in the electrodischarge treatment in the 1st phase to the processed material by this invention are chosen, an electrode does not collapse and the metal finishing method of changing electrode polarity and electric discharge electrical-and-electric-equipment conditions into the conditions which go up a degree of hardness in the electrodischarge treatment in the 2nd phase to the abovementioned processed material can perform deposition, remelting, and processing processing of a lump [carve].

[0025]

[Example]

One example of this invention is explained about drawing below example 1. First, creation of an electrode is explained. In the electrode of only compacting like before, since the electrode might collapse in secondary elaboration conditions, after mixing and pressing tungsten carbide powder and cobalt powder (powder of WCCo), the temporary-quenching join was carried out at this example. Each condition is as being shown in Table 1.

WC + Co
compress + heat at
1100°C

[0026]

[Table 1]

粉体	粒 度	混合比	成形圧力	焼結温度
WC	1.0μm	60重量%	10t/cm²	真空炉 1100℃ 昇温11時間 保温30分 降温4時間
CO	1.38μm	40重量%		

[0027] Next, processed material is set to SK3, the green-compact electrode of the temporary-quenching join which showed the front face to the grinding side and showed the electrode in the above-mentioned table 1 is used, and surface treatment by the electron discharge method is performed. 5-25A, and pulse period taup set [current value Ip] quiescent time taur constant with 1024 microseconds for 4 to 1024 microseconds.

[0028] Drawing 1 shows the pulse peak value, the pulse quiescent time, and the processing state at the time of switching an electrode to minus and plus, respectively, and if an electrode is minus, it has the field deposited to processed material. The inside of this drawing and a horizontal train are pulse peak value IP, and a column is pulse period tauP. It is shown and processed material is sometimes processed with "****", without depositing. Such a **** field is removable choosing electric discharge electrical-and-electric-equipment conditions and by lowering sintering temperature. If an electrode is plus, remelting processing can be performed for what the electrode deposited in minus. If a **** field chooses electric discharge electrical-and-electric-equipment conditions or sintering temperature is lowered like the above, it is removable. Moreover, a degree of hardness rises [the direction at the time of processing it by plus] rather than the degree of hardness of a surface layer when an electrode processes it by minus.

[0029] If an electrode is plus, this reason will be considered because the electric discharge marks current density of processed material becomes high and a result which reheated at high sintering temperature is brought, as processed material is subtracted and it is shown in the assumption model view to the behavior of the arc column of drawing 2 , and electric discharge marks formation. In addition, 13 of drawing 2 shows the expandable part of the electrode at the time of making an electrode 1 into minus polarity. Drawing 3 shows the cross-section degree-of-hardness distribution of this surface treatment layer.

[0030] In addition, drawing 4 - drawing 7 show the cross section of the processed material which performed surface treatment, the processing layer cross section and drawing 6 which drawing 4 switched the polarity of an electrode to the surface treatment cross section for floor-to-floor-time 30 minutes, and drawing 5 switched it to minus and plus, and carried out the electron discharge method show the processing layer cross section of the processed material of a variant configuration, and drawing 7 shows the cross section of the processing layer of a weld zone, respectively.

[0031] As shown in the above example, it is clear that the WC-Co electrode's which carried out the

temporary-quenching join the following properties are shown. Even if it carries out a temporary-quenching join, there is a field which deposits an electrode to minus polarity, then processed material. Although plus polarity, then deposition are not carried out, they can remelt what was once deposited and can raise a degree of hardness.

[0032] It became clear that electric discharge is continuable, without collapsing, whether an electrode does not collapse even if it changes polarity into plus and minus, and it repeats a dipole inversion or it repeated frequently at high speed.

[0033] Moreover, even if it takes a high duty factor, it can collapse, or it is [stop / **********] easy to concentrate electric discharge, and processing efficiency can be gathered.

[0034] It is clear that unlike what only touches like a green compact also from another experiment the combination in fine particles becomes strong by the temporary-quenching join, electric resistance becomes small, and thermal conductivity is also high. Of course, electric resistance is high and the thermal conductivity of a low thing is more natural than what was sintered completely (high temperature processing).

[0035] Although a firm sintered compact will be done like sintering of a green compact of the usual sintered alloy or fine ceramics if it heats to sintering temperature if the above-mentioned example is explained further, then an electrode serves as non-expendability and it becomes impossible to cause deposition to processed material. Therefore, sinter the means which this invention person chose at low temperature rather than (1) sintering temperature.

(2) Endowment of the property that expendability and non-expendability conflict is conversion of electrode polarity, and change of the electric discharge electrical-and-electric-equipment conditions at that time, and hit on an idea of it from assumption (temporary construction of an artificer) of the arc model of electric discharge generating shown in drawing 2

[0036] The matter of the above (1) is explained here. The general inclination of sintering is shown in drawing 8 , sintering time is shown in the horizontal axis and relative density is shown in the vertical axis. Although theoretical relative density will be approached if it sinters at an elevated temperature, if it sinters at low temperature rather than it, low relative density, i.e., intensity etc., will become low. Drawing 9 shows the sintering temperature of alumina ceramics, and apparent density, and sintering time is shown in the horizontal axis and it shows apparent density to the vertical axis. If it sinters above 1600 degrees C, theoretical density will be approached remarkably. In this invention, it becomes the range for which 50%- about 90% of theoretical density is used, and rather than as [of a green compact], it becomes strong enough by **** enough, and electric resistance is also small and thermal conductivity also serves as size from full sintering.

[0037] Next, the matter of the above (2) is explained. Although primary processing is performed on the conditions which an electrode exhausts and secondary elaboration is performed on the conditions of an electrode wear which become small, exhaustion of an electrode can be controlled by choosing polarity to be shown in the assumption model view to the behavior of the arc column of drawing 2 , and electric discharge marks formation. That is, when an electrode is minus, as shown in drawing, a minus side has a thin arc column by the electric discharge from one, and a plus side becomes thick. Since the discharge current is fixed, the electric discharge marks current density by the side of minus becomes remarkably high, and the exhaustion by the side of minus increases.

[0038] Conversely, since, as for a plus side, electric discharge marks current density becomes low relatively, exhaustion decreases. Therefore, what is necessary is just to take a large discharge current value, in order to make current density of electric discharge marks into size further to exhaust an electrode remarkably, while making polarity minus.

[0039] Moreover, what is necessary is to consider electrode polarity as plus and just to lower the current value of electric discharge marks, in order to make an electrode into non-expendability. In order it is long in current pulse time taup in order to make it un-exhausting, since the current density of the electric discharge marks from one becomes low so that current pulse time taup is long, and to consider as plus polarity and to make it an ablation form, what is necessary will be to be short and just to make current pulse time taup into minus polarity.

[0040] The following new examples can be produced based on the property more than example 2. That is, the polarity of an electrode is repeated to minus and plus by several 10 times of frequency in 1 minute. The degree of hardness of a processing side rises more by this processing method.

Moreover, a thick surface layer can be made. Or machined surface granularity can form a detailed and thick enveloping layer.

[0041] After processing a temporaryquenching join electrode into the purpose configuration with machining or ultrasonic machining, a mold cavity is made by making this into a processing electrode (a configuration is carved). The few electrode [exhausting] of polarity at this time of plus polarity improves the configuration precision of configuration processing. Next, deposition processing is performed by considering polarity of an electrode as minus (primary processing). Remelting processing is performed to the degree by considering polarity of an electrode as plus. If it does in this way, even if it will not use a conventional copper electrode or a conventional graphite electrode, configuration processing of a cavity can be performed, and hard-facing can be performed after that.

[0042] Deposition and remelting sintering are attained also in the field which will be carved to steel materials by the electrode which carried out the temporaryquenching join of the easy material of carbonization, such as TiC, Ti, or V or Ta, for processed material to the front face of a thing like material with the melting point higher than about 1500 degrees C, for example, the nature alloy of superhard, like steel materials if it is processed converting electrode polarity.

[0043] If electric discharge surface treatment is performed lubricating at the same time it makes a temporary-quenching join electrode into the shape of a wheel (disc-like) and gives rotation, as shown in drawing 10 , it is processible, improving circulation of a working liquid. Moreover, since the amount which a temporary-quenching join electrode exhausts can be distributed to the whole disk, it is useful to hardening of a cutting tool or part processing. That is, they are that it is useful to perform a cutting tool and part processing by the grinder, and homonymy.

[0044] In drawing 10, the insulating spindle with which a working liquid and 23 rotate a power supply and, as for 24, a rotation wheel and 22 rotate [20 / 21 / processed material and] an electrode 21, and 25 show the brush, and 26 shows the rotation belt. In additiodrawing 11 is the cross section of a wheel 21, and 27 shows the electrode with which the wheel 21 was equipped.

[0045] In addition, when performing hard facing with regrinding of a cutting tool by the temporary-quenching join electrode, the structure united with the diamond grinding wheel can also be taken. That is, the periphery section of a diamond wheel is used for regrinding, and the structure of sticking a temporary-quenching join electrode on the inner circumference section is taken.

[0046] The diamond with which the wheel was equipped with 30 and the wheel 30 was equipped with 31, and 32 show [in drawing 12 / drawing 12shows the cross section and] the temporary quenching join electrode.

[0047]

[Effect of the Invention] As explained above, since the electrode for electric spark machining by the 1st invention pressed the simple substance of nitrides, such as borides, such as carbide, such as WC, TiC, TaC, ZrC, SiC, and VC, and TiB2, ZrB2, and TiN, ZrN, or two or more sorts of mixture, and they carried out the temporaryquenching join and it constituted them from temperature below sintering temperature after that, an electrode does not collapse to polar conversion or wide range electric discharge electrical-and-electric-equipment conditions.

[0048] Moreover, since the electrode for electric spark machining by the 2nd invention carried out the temporary-quenching join of the green compact of an easy material of carbonization, such as Ti, V, and Ta, and constituted it from temperature below sintering temperature, an electrode does not collapse to polar conversion or wide range electric discharge electricaand-electric-equipment conditions.

[0049] Moreover, the metal finishing method by electric discharge by the 3rd invention Borides, such as carbide, such as WC, TiC, TaC, ZrC, SiC, and VC, and TiB2, ZrB2, This by performing an electrodischarge treatment to processed material as a consumable electrode of an electron discharge method by adding and pressing sintering support into a simple substance or two or more sorts of mixture, and carrying out the temporaryquenching join of the nitrides, such as TiN and ZrN, at the temperature below sintering temperature after that Since the enveloping layer was formed in the above-mentioned processed material front face, if an electrode does not collapse to polar conversion or wide range electric discharge electricaand-electric-equipment conditions and an electrode is used continuously, an electrode front face will be sintered and a degree of hardness will be increaized.

[0050] Moreover, the metal finishing method by electric discharge by the 4th invention Carry out the

temporary-quenching join of the green compact of an easy material of carbonization, such as Ti, V, and Ta, at the temperature below sintering temperature, and after that, since an electrodischarge treatment is performed to processed material into the working liquid which produces carbon by the pyrolysis according this to electric discharge as a consumable electrode of an electron discharge method If an electrode does not collapse and an electrode is continuously used after acting deposition, remelting, etc. enough also to polar conversion or wide range electric discharge electrical-and-electric-equipment conditions, an electrode front face will be sintered and a degree of hardness will be increase-ized.

[0051] Moreover, since the metal finishing method by electric discharge by the 5th invention changes electrode polarity and electric discharge electrical-and-electric-equipment conditions into the conditions which choose the conditions which an electrode material deposits well in the electrodischarge treatment in the 1st phase to processed material, and go up a degree of hardness in the electrodischarge treatment in the 2nd phase to the above-mentioned processed material, an electrode does not collapse and it can perform deposition, remelting, and processing processing of a lump [carve].

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the pulse peak value, the pulse quiescent time, and the processing state at the time of switching the electrode by the example of this invention to minus and plus, respectively.
[Drawing 2] It is drawing showing the assumption model to the behavior of an arc column and electric discharge marks formation explaining the example of this invention.
[Drawing 3] It is drawing showing the crosssection degree-of-hardness distribution of the surface treatment layer obtained according to the example of this invention.
[Drawing 4] It is the surface treatment cross-section photograph of the processed material for floor to-floor-time 30 minutes obtained according to the example of this invention.
[Drawing 5] It is the processing layer cross-section photograph of the processed material which switched and carried out the electron discharge method of the polarity of the electrode obtained according to the example of this invention to minus and plus.
[Drawing 6] It is the processing layer cross-section photograph of the processed material of the variant configuration acquired according to the example of this invention.
[Drawing 7] It is the cross-section photograph of the processing layer of the weld zone obtained according to the example of this invention.
[Drawing 8] It is drawing showing the general relation between density change of a sintered compact and sintering temperature which were sintered with constant temperature.
[Drawing 9] It is drawing showing the relation between the sintering temperature of alumina ceramics, and apparent density.
[Drawing 10] It is a block diagram explaining other examples of this invention.
[Drawing 11] It is the cross section of the wheel shown in drawing 10
[Drawing 12] It is the cross section of the diamond wheel explaining the example of further others of this invention.
[Drawing 13] It is the general block diagram of electron discharge method equipment.
[Drawing 14] It is the general block diagram showing the control circuit of electron discharge method equipment.
[Drawing 15] It is drawing showing the pulsevoltage wave in a working gap, and a pulsecurrent wave.
[Description of Notations]
1 Electrode, 2 Processed Material, 3 Processing Tub, 4 Working Liquid, 5 Servo Mechanism
6 Power Supply, 8 Transistor 9 Transistor 10 Resistance
11 Resistance, 12 Control Circuit 15 ElectrodeWear Portion 20 Processed Material
21 Rotation Wheel, 22 Working Liquid, 23 Power Supply, 24 Insulating Spindle
25 Brush, 26 Rotation Belt, 27 Electrode, 30 Wheel
31 Diamond, 32 TemporaryQuenching Join Electrode

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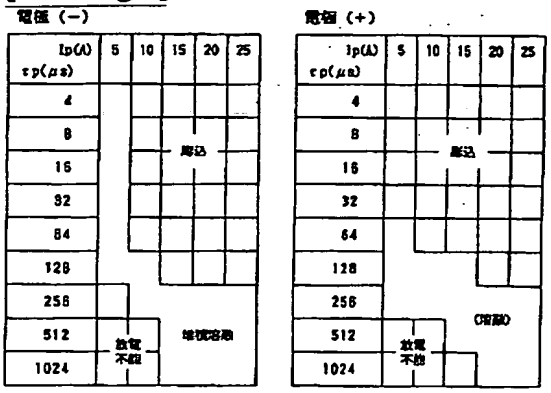
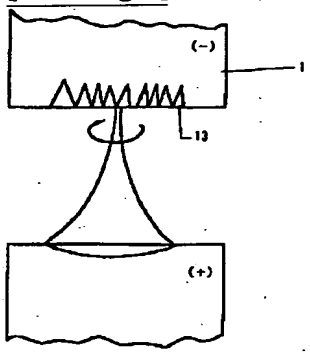
3.In the drawings, any words are not translated.

DRAWINGS

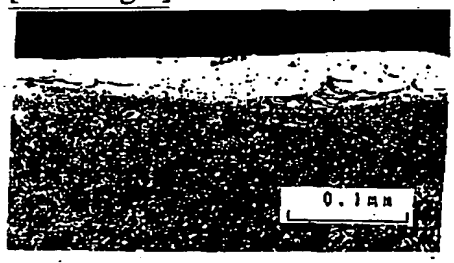
[Drawing 1]



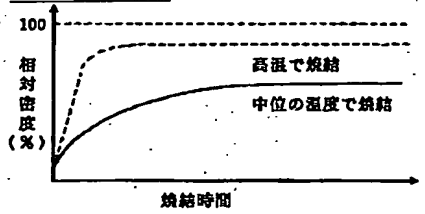
[Drawing 2]



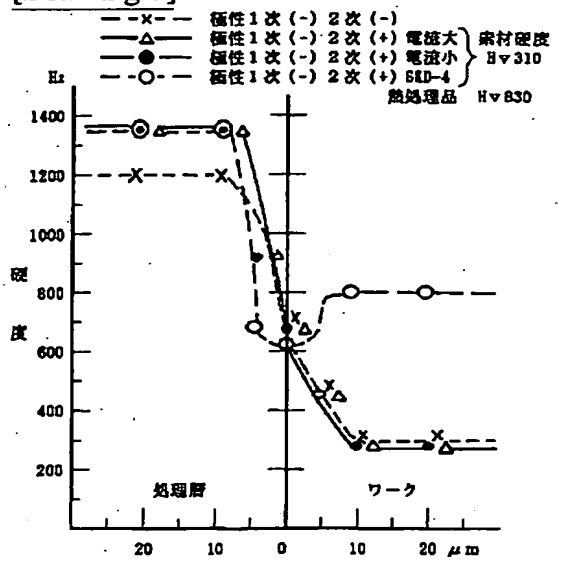
[Drawing 5]



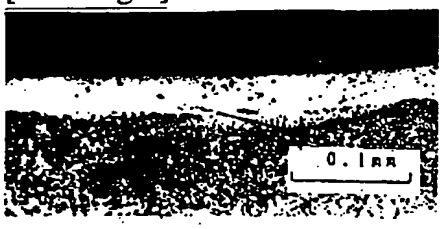
[Drawing 8]



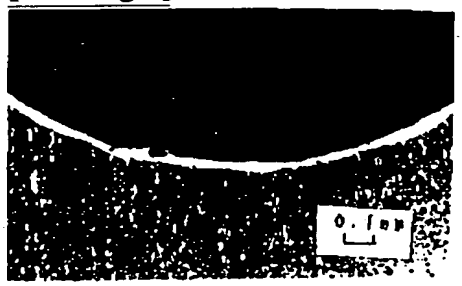
[Drawing 3]



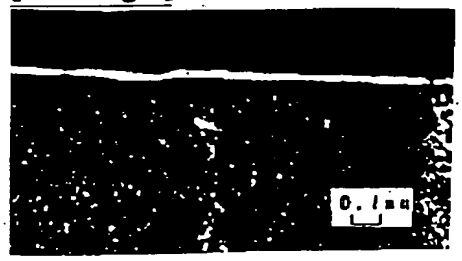
[Drawing 4]



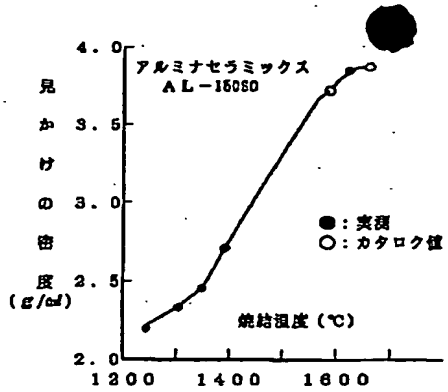
[Drawing 6]



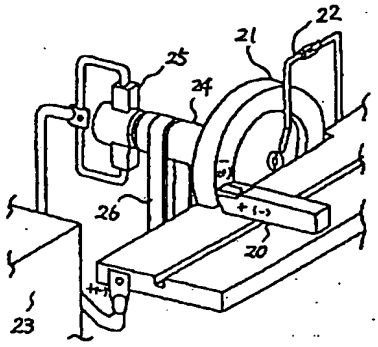
[Drawing 7]



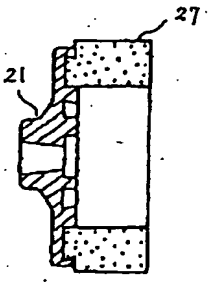
[Drawing 9]



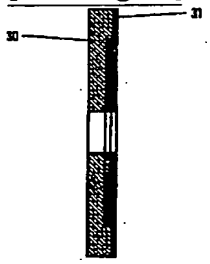
[Drawing 10]



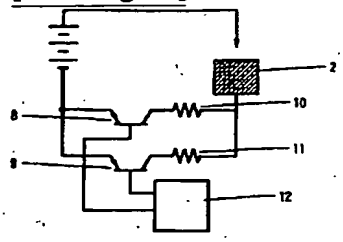
[Drawing 11]



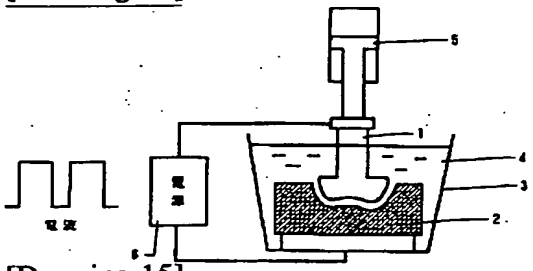
[Drawing 12]



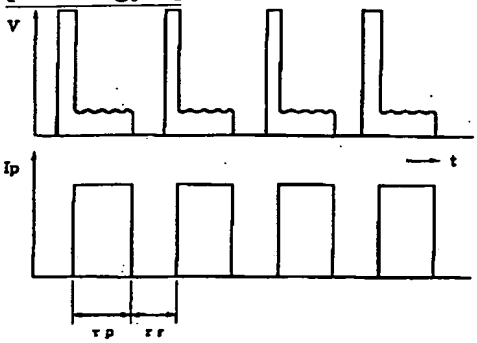
[Drawing 14]



[Drawing 13]



[Drawing 15]



[Translation done.]